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ABSTRACT

New technical specialties are emerging within the computer industry at a rate threatening the ability of educational institutions to train those who would understand and apply them. The industry's ability to undertake more ambitious projects and to thereby solve more complex problems is limited by an inadequate force of skilled manpower. Thus, it finds itself in the following position: (1) there exists a distressingly large number of poorly qualified people at all levels; (2) those who are now competent are becoming less so every day as technological developments continue; (3) long-term career prospects for data processing people in most user organizations are not sufficiently promising to attract the talented; (4) universities are turning out far too few computer-oriented problem-solvers; and (5) the industry is having a difficult time achieving professional maturity. The solution of these problems will require considerable effort. (Author/WCM)

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Shaping Computing and Information Processing as a Vital
National Resource.

George Glaser, President

American Federation of Information Processing Societies

Keynote Address before the 1974

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George Glaser was elected President of the American Federation of Information Processing Societies, Inc. in June, 1973.

Mr. Glaser is an independent management consultant with offices in San Mateo, California. Prior to establishing his own consulting practice, he was a principal of McKinsey & Company, Inc., an international management consulting firm, and was in charge of the organization's Menlo Park satellite office. Prior to joining McKinsey in 1961, he served as a product planner and product manager at Ampex Corporation and as a staff member at Sandia Corporation.

In recent years, much of Mr. Glaser's attention has been devoted to management problems in technology-based companies with particular focus on product/market strategies in the data processing and communications industries and in the management of large-scale computer/communications development projects.

In my remarks this morning, I want to pose some tough questions and ask you to think about them during the coming week—a week in which you will have a unique opportunity to learn of new developments, see new products and services, and swap war stories with your colleagues. These questions, and others like them, are being raised by certain thoughtful people in our industry who are beginning to ask that we take stock of what we have accomplished and where we are going. This kind of critical self-examination is healthy—and overdue.

Because they're tough questions, I don't expect that we can come up with ready answers for them. But because they're important questions, they ought to be discussed at meetings like this which bring together some of the best minds in the industry.

Much of what I have to say is directed to the management of those companies, governmental agencies and institutions that use computers; and to the career managers, analysts, programmers, and technical support personnel who earn their living by applying the tools of our trade. Hopefully, these remarks will also have meaning to those of you who design products and provide services for others.

So much for the preamble—

Things are happening in computing: technology continues to advance at a rapid rate; our appetite for more advanced, more imaginative, and more pervasive applications seems insatiable. Growth is everywhere—in the number of machines installed, in the range of their size and power, and in the sophistication of those who use and depend on them. And very large sums of money are being spent—nearly \$30 billion this year (approximately \$150 for every man, woman and child in the U.S.).

We are, in short, doing a land-office business.

Yet, I'm uneasy about certain aspects of our success—specifically, those that have to do with the quality and quantity of professionals who practice the somewhat

arcane arts of information processing.

For most of our brief history we have been machine-oriented. To be less kind, we have been machine-mesmerized. As a result, we have scarcely recognized—and certainly have not adequately dealt with—the fact that we have become a people-intensive industry.

Salary costs today are nearly 50 percent of the total in a typical data processing budget and they continue to increase, both in absolute amount and, more importantly, as a percentage of total budgets.¹ At the same time, hardware costs, which now are approximately 40 percent of a typical budget, continue to decrease as a percentage of total budgets because of continued developments in electronics fabrication and in storage techniques.

Yet in spite of our acknowledged technological progress, it now takes more—not less—skill to design a system, to get it on the air, and to keep it running smoothly.

New technical specialties are emerging at a rate threatening the ability of our educational institutions (and our vendors) to train those who would understand and apply them. And the skills needed to manage this cauldron of increasing complexity continue to elude all but the most agile of mind, strong of will, fleet of foot, and fat of budget.

Now, more than ever before, our ability to undertake more ambitious projects and to thereby solve more complex problems is limited by our ability to muster an adequate force of skilled manpower.

We find ourselves in the following position:

1. There are a distressingly large number of poorly qualified people at all levels, particularly in user development organizations.
2. Those who are now competent are becoming less so every day as technological developments continue at an overwhelming rate.
3. Long-term career prospects for data processing people in most user organizations are not sufficiently promising to

attract the talented young men and women who could add to and strengthen our supply of available professional manpower.

4. Our universities are turning out far too few computer-oriented problem solvers.
5. We are having a painfully difficult time achieving the level of professional maturity that would help stimulate and reward the continued self-renewal of individual competence.

We are, it would seem, plunging headlong into an energy crisis of our own. We are building and installing powerful machinery for which we already have an inadequate supply of its most important fuel element—the talents of our people—and we are doing far too little to maintain and replenish that supply.

I'd now like to discuss in more detail each of these five points. First, the matter of competence in the development of new applications.

One of the most respected men in the industry, Professor Dr. Edsger W. Dijkstra, who later this week will be presented with the AFIPS Harry Goode Memorial Award, suggested in his Turing Lecture² at the 1972 Annual Conference of the Association for Computing Machinery that “perhaps the programmers of the past decade have not done so good a job as they should have done. Society is getting dissatisfied with the performance of programmers and of their products.” He goes on to point out that we cannot expect society to accept “the same clumsy and expensive (software development) process” that we now follow.

Another critic, Gerald H. Larsen, made the observation in a recent Data-
mation article that: “If 50 percent of the people involved in systems and software in the United States suddenly lost their jobs, not a single project would be delayed.”³ He further stated: “The Computer industry has mushroomed like an atomic cloud, carrying with it . . . a large number of fundamentally incompetent individuals (who), untrammelled by their lack of capability, have remained in our industry and have been promoted into some rather remarkable job descriptions.”

Larsen also noted that many people credit the software industry with "the virtues of an almost complete lack of discrimination." But he added: "More correctly, not only do we provide equal opportunity regardless of race, creed, color or sex; we also provide it regardless of ability."

These are harsh words and I am confident that Larsen's 50 percent figure was not intended to apply to a random population of software designers. Nonetheless, his indictment is severe.

Still another cry for self-examination was made by Dr. Harlan Mills in a brilliant essay titled "On the Structure of a Computing Profession."⁴ Mills lamented that:

"Computer systems are dangerously out of control in several dimensions today. They are out of control with respect to social integrity, with respect to fiscal integrity, and with respect to cost and productivity . . . (A)n honest and industrious lack of competence has produced a staggering overkill in cost and effort in programming . . . For an industry dealing with laboratory curiosities and using a barely noticeable fraction of the nation's resources, that may be a tolerable expense for research and progress. But the computer industry is now eleventh in size in the country, and will be third in size by 1980. If that growth were an honest reflection of efficiently generated services for the country, it would be an achievement of great pride. But a significant fraction of that growth represents a form of bumbling blackmail of a nation and its institutions which are struggling to cope with new demands and complexities in today's changing world."

Should we dismiss such comments as the railings of latter-day Cassandra? I think it would be unwise to do so. Instead, we should listen carefully. Our industry as a whole must, in conscience, suffer some pangs over its inability to design and build efficient and reliable software.

But even if you feel that I, or the critics I quoted, have overstated the lack

of current competence, consider my second point—that our technology continues to develop at a rate that defies our ability to keep up with it and that, as a result, those who are now competent will inevitably become less so. This phenomenon—known as technological obsolescence—is endemic among our ranks. We are becoming, to bend an old Pennsylvania Dutch phrase, too fast old, too soon dumb.

Consider the implications of technological obsolescence for those of you who have chosen a career in data processing—whether as a programmer or analyst or as one who manages people with those skills. I suggest you begin with the Paul Principle, articulated by Paul Armer of the Center for Advanced Study in the Behavioral Sciences.⁵ According to the Paul Principle: "Individuals often become incompetent over time at a level at which they once performed well, because they become 'uneducated' (technologically obsolete) for that level."

Armer points out that, without continuing education, the professional may become obsolete long before retirement and that this is not only a problem for the individual, but also for his organization.⁶ And I would add, for those whom his organization serves: customers, stockholders, and the general public.

To take Armer's conclusion even one step further: as the computer becomes more and more vital to the very functioning of our economic system, technological obsolescence of computer professionals becomes a national problem.

Yet how much do we spend to maintain and enhance the skills of our people so as not to squander our most precious resource? A recent survey¹ indicates that the typical 1974 DE budget includes substantially less than 1 percent for the out-of-pocket costs of training, conferences, and related activities. In dollar terms, this is an investment of approximately \$700 per professional per year. Perhaps that is an appropriate, even generous, amount to invest. But even if the amount is appropriate, our training often is wasteful and

shortsighted because it is concentrated on more and more specialized subject matter with correspondingly shorter and shorter half-lives for those who are trained.

My third point was that the long-term career prospects for data processing people in most user organizations are not sufficiently promising to attract the talented young men and women who could add to and strengthen our supply of professional manpower.

Talented people are attracted to a profession because (1) they think the work would be challenging and interesting (or just plain fun), and (2) because they look forward to a rewarding career.

For most of us, the computing profession meets the first test. We enjoy working with computers.

But does it meet the second criteria of a rewarding career? I, for one, have misgivings. Suppose, for example, you aspire to be a DP Manager in a user organization some day (after you become obsolete) because you then wouldn't need to rely as heavily on your technical skills.

Whatever your reasons, it is presumably better to be the DP Manager than to report to him. Perhaps so, but it's no guarantee of either fame or fortune. According to data compiled by the American Management Association, the top DP executive is the next to the lowest paid manager at that level in the average company, surpassing only the top transportation executive.⁷

That's a shattering statistic. There was a time, not too long ago, when many of us felt that a DP career within a user organization provided an excellent opportunity for a shot at a top management job. We had visions of the top DP executive reporting directly to the President of the company.

We're sadder but wiser now. We know from experience that this is rarely the case. In most mature organizations, the DP department has ceased being passed back and forth between administration, finance, and operations—in the early days, because everyone wanted to control it, but later because no one wanted to be blamed

for it. And when it finally comes to rest, it typically does not report to the President (nor do I think it should, except in unusual circumstances).

I've been troubled for some time by what I believe is a lack of political clout among DP Managers, particularly among those whose outlook is perceived to be—and often is—too narrow. Perhaps this is so because they have necessarily had to focus their energies on managing a difficult and challenging technical specialty. Perhaps they have had little time to develop the kind of broad general management skills that would qualify them as candidates for executive positions.

For whatever reason, DP Managers seldom are given the opportunity to participate personally in the tough decisions that develop and temper the skills of other executives. As a result, they are likely to retain their image as narrow specialists unless they make a concerted personal effort to redirect their careers—admittedly a tough assignment for anyone, and particularly so for the unfortunate soul who has been categorized—however unfairly—as an obsolete manager with no clout.

If you have not yet read "Plight of the EDP Manager,"⁸ an article written by Professor Richard L. Nolan of the Harvard Business School, I strongly recommend that you do so. My recommendation applies equally to those of you who are Managers of DP Managers, to those of you who are now DP Managers, and to those of you who would like someday to be DP Managers. Nolan's thoughtful and perceptive article recognizes that the DP Manager has a tough job indeed and that he often is a scapegoat because of his own inadequacies and those of the people to whom he reports.

I would not argue that people should abandon their data processing careers to "get ahead." On the contrary, we must find ways to upgrade and broaden the skills of individuals so as to improve their ability to produce consistently superior results. In so doing, we also would materially improve their ability to gain the recognition they so earnestly seek.

Point number four: our universities are turning out far too few computer-oriented problem solvers. The quality and quantity of computing science education in this country and around the world has developed strongly in a very few years. But is it reasonable to expect graduates of most existing programs to be the hard-headed pragmatists needed to apply our technology? I think not.

Harlan Mills, whom I quoted earlier, urges us to take a lesson from the commonly used phrase "the Practice of Medicine." He suggests we start by recognizing that medical schools teach various aspects of this practice, such as surgery and radiology, while other schools teach matters such as biology, zoology, and chemistry which, although of deep interest to medicine, do not address the *practice* of medicine directly. Mills argues that Computer Science does not address the *practice* of computing; that good programmers are and will continue to be the products of practical rather than university education.

What we desperately need are professional problem solvers, trained to practice computing—the kind of problem solvers who fully understand the burdens of the innovator who, as you no doubt are well aware, has as his enemies all those who prospered under the old regime, and as lukewarm supporters all those who might prosper under the new.

Unless, and until, we develop a significant capability to produce pragmatic problem solvers, we shall continue to turn out individuals for whom the "agent of change" role is distasteful and frustrating.

This brings me to my fifth point: We are having a painfully difficult time achieving the level of professional maturity that would stimulate and reward the continued self-renewal of individual competence.

In my view, this is because we spend more time talking about professionalism in this industry than we do acting like true professionals.

Many of you belong to one or more professional societies. Presumably, you think of yourself as a professional man or

woman. But do you *act* as a professional so as to merit not only the appellation but also the respect that goes with it? And do *they*—the public, your boss, your co-workers, your customers—think of you as a professional and treat you accordingly?

Let's step back for a moment and consider just what it is that distinguishes the professional. A professional is one who contributes to the advancement of the arts that he or she practices . . . one who is driven by a desire for excellence . . . one who welcomes opportunities to improve the way things are done and who seeks out those opportunities . . . one who accepts the responsibility to advance the knowledge and skills of his fellow men and who is willing to make the personal sacrifices that go with it.

Professionals help people. They do not worship things. Yet it seems to me that far too many computer people are unduly impressed with their machines. They're very much like hi-fi fans or auto enthusiasts. And the more zealous of them act as though use of the computer were inevitably good; whereas it often can be questionable, or even precarious.

Our profession is peculiar in some respects. Like many others, it has developed in an empirical way. But it has been unlike engineering, which started long ago by trying to solve human problems such as making fire, preparing the earth for planting, and later building roads, bridges, ships and machines. It is also unlike medicine, which started by trying to cure human sickness, and struggled through magic, alchemy, empiricism, and experiment, and on to science.

Professions generally travel a long road to maturity. In doing so, they slowly unravel that knowledge of nature and their environments on which their maturity depends.

By contrast, the profession of information processing developed rapidly—it can be considered, at most, three decades old. Its motivations have rested largely on finding uses for novel, powerful, and versatile types of machines. This reverse

approach has permitted us little time to develop professional maturity.

Our profession differs, too, from engineering and medicine in that we provide tools for others to use. This confronts us with a problem of communication. Unless we know the user's problem, can speak precisely about the abilities and limitations of computers, and can intelligently relate the two, unrealistic expectations may be aroused and wastefulness may occur. Furthermore, our inability to communicate effectively dooms us to continued frustration in accomplishing our professional and personal objectives.

Professional maturity requires that we start with people and their problems much as engineers and physicians do. We must view computers as tools which can sometimes help them and sometimes not—but always with the idea of helping people and not, *per se*, advancing the use of computers.

Maturity in a profession requires that the good it does be obvious. Here we have a very difficult challenge. Data processing equipment worth approximately 9.5 billion dollars was shipped by U.S. manufacturers last year. But this does not give us a measure of the good accomplished with it, especially in managerial fields. To the extent that we can, we should evaluate benefits and willingly agree to critical auditing of results. For the glamour will wear off of computers, as it has done with electronics, and then our profession will stand naked before the world, except as it can be clothed with demonstrable utility.

A recently retired senior engineering executive of one of the largest electrical equipment manufacturers in the United States wrote to me as follows: "I sponsored the introduction of a large production and inventory control system in (one of our biggest plants). It operates successfully. But as I think about it, I cannot for the life of me say precisely how much better off we are than with the old methods, and whether it has been worth its cost. Too many intangibles enter production planning. I guess we were progressive because 'everybody is doing it.' But I don't know."

The man who wrote this letter has a long and distinguished record of technical achievement. He has been a strong proponent of the aggressive and imaginative use of information processing. He knows the rewards, and hazards, of the innovator. And his uneasiness should give us pause.

As I perceive the professional innovator, both maturity and humility are useful traits—particularly when unleashing powerful tools on a world that has little understanding of their limitations.

Unfortunately, neither maturity nor humility have been hallmarks of our trade. Nor perhaps would we be where we are if they had been. It took courage—even brashness—to create a major industry from scratch in only thirty years. But we are upstarts, and we often cause feelings of apprehension and even resentment. And that's unhealthy.

We are not, to use the words of the Good Book, "advancing in wisdom and age and grace before God and men."⁹ I believe we badly need a dash or two of wisdom, and that we certainly could use a generous helping of grace.

Allow me to define "grace" in this context to mean the ability to practice our profession in such a way that our users (including the public) view us as having been helpful and, as a result, render to us the kind of healthy respect shown for other professionals who, like ourselves, practice arts that, while also somewhat arcane, are useful to people.

But it is one thing to throw down the gauntlet. It is another to pick it up.

I sincerely believe that the issues which I have outlined are both real and pressing and that we all have a stake in resolving them—and in doing so quickly because they will not go away.

Whatever the solutions may be, they must flow from all of us—from leaders of our industry, from those who aspire to be labeled computer professionals, from concerned user-management, and certainly from those societies and professional groups that speak for a significant portion of our field.

As the leading such professional group in the United States, the American Federation of Information Processing Societies is attempting in several important areas to serve the computing field and to provide, we hope, a few of the solutions. AFIPS, as many of you know, represents thirteen professional societies engaged in the information processing sciences and their applications.

Perhaps most relevant are our efforts to broaden our outlook. We also have launched programs pointed toward improving the quality of systems design and sharpening our understanding of professionalism.

Let me sketch each of these areas for you briefly. I am sure that many of you are aware that the Data Processing Management Association has applied for membership in AFIPS, their application subject only to ratification by their International Board of Directors at its meeting next month. We view this as most significant and look forward to a favorable vote on their application by the AFIPS Board of Directors that would inaugurate their participation in our future activities. Moreover, their membership in AFIPS should help our profession speak with a more unified voice.

Our efforts to improve the quality of systems design began with consideration of the possibility of certifying systems—especially those that affect public safety and welfare. We soon came to the conclusion that not only is it impossible at present to define necessary standards for systems certification but it is extremely difficult to specify preferred practices. As a result, we have focused our attention on questions that should be asked by any manager as he attempts to decide whether or not his systems are well designed and will perform in the desired way. As the first product of this effort, our Systems Improvement Committee will soon complete a manual covering privacy and security.

In the area of professionalism, our efforts have centered on defining what con-

stitutes a computer or data processing "professional." Our initial conclusions were two-fold—one, that standard job descriptors are essential to anyone who intends to assess performance; and secondly, that professionalism implies something more than performance per se—at a minimum, it must represent a wedding of attitude and ethics along with the search for technological excellence.

To carry on this work, AFIPS has established a Professional Standards and Practices Committee which has taken as one of its first tasks the development of comprehensive job descriptors for computer programmers, and an investigation of their relevance to training and possible certification.

A report on the committee's work on programmer job descriptions has now been completed. We believe it will help provide continuity among job levels, both within a given organization and among a variety of organizations, and may lead to an enhanced understanding of professional competence and performance.

Both the report on programmer job descriptions and the manual on privacy and security will be published shortly by AFIPS Press. Our objective is to disseminate the results of our projects as widely as possible throughout the private sector and also throughout the various levels of government.

In connection with the latter, AFIPS is seriously considering taking a more active role in bringing together the professional societies of AFIPS and the various elements of government interested in computing activities. We hope to establish a program that will (1) assist the Federal Government by supplying technical advice and assistance, when requested, on computer-related issues, (2) improve communications between industry, academic institutions and federal agencies concerning research and development in computer science and engineering and, (3) supply information to the AFIPS Constituent Societies about federal activities and policies affecting our field.

Such commitments and efforts on the

part of AFIPS and its Constituent Societies are intended to provide partial solutions to the problems I have cited. But each of us—individually and collectively—has a personal responsibility for shaping computing and information processing as a vital national resource. We cannot abdicate that responsibility by paying dues to a professional society (or two) and then remaining silent.

I firmly believe that the wisdom we so badly need will come more readily to all of us if we think hard about what we are doing—and why! And respect will come more readily if we can demonstrate our ability to deliver solid, workable solutions to important and real problems, particularly (to introduce a crass note), if we do so on time and within budget.

I'm bullish about computing and about the computer industry. But it is time for introspection—as unsettling as it may be.

Introspection can be rewarding, and we desperately need it so that wisdom and grace in the computer industry can keep up with its age.

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The American Federation of Information Processing Societies, with national headquarters in Montvale, New Jersey, is a Federation of thirteen professional societies involved in information processing technology and its application. As such, the Federation acts on behalf of the more than 130,000 members of its Constituent Societies on matters of broad importance to the advancement of computer science and data processing as a responsible profession.

The Federation is dedicated to non-profit scientific and educational purposes. Its primary objectives include the undertaking of joint activities on behalf of its Constituent Societies, the promotion of cooperation and information exchange among various professional and governmental groups, participation in nonprofit international organizations concerned with information processing, the undertaking of research and development activities, dissemination of reliable information on information processing to the general public, and provision of services to its Constituent Societies.

As part of its activities, AFIPS sponsors the annual National Computer Conference plus additional conferences, seminars and symposia.

Constituent Societies

American Institute of Aeronautics and
Astronautics

American Institute of Certified Public
Accountants

American Society for Information Science

American Statistical Association

Association for Computational Linguistics

Association for Computing Machinery

Association for Educational Data Systems

IEEE Computer Society

Instrument Society of America

Society for Computer Simulation

Society for Industrial and Applied

Mathematics

Society for Information Display

Special Libraries Association